



University of  
St Andrews

### Safe working in confined spaces

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# University of St Andrews

## Guidance on Work in Confined Spaces

### 1. Introduction

1. The following section is based on the HSE Guidance 'Safe work in confined spaces. Confined Spaces Regulations 1997' (L101) (2009).

### 2. What is a confined space?

A 'Confined Space' is any space of an enclosed nature where there is a risk of death or serious injury from hazardous substances or dangerous conditions (e.g. lack of oxygen). It does **not** mean a restricted space eg in a small tight loft etc where there is no immediate threat to life due to toxic fumes or lack of oxygen.

Some confined spaces are fairly easy to identify, e.g. enclosures with limited openings:

- storage tanks;
- silos;
- reaction vessels;
- enclosed drains;
- sewers.

Others may be less obvious, but can be equally dangerous, for example:

- open-topped chambers;
- vats;
- combustion chambers in furnaces etc;
- ductwork;
- unventilated or poorly ventilated rooms.

It is not possible to provide a comprehensive list of confined spaces. Some places may become confined spaces when work is carried out, or during their construction, fabrication or subsequent modification.

### 3. What are the dangers from confined spaces?

Dangers can arise in confined spaces because of:

1. A lack of oxygen; This can occur:
  - where there is a reaction between some soils and the oxygen in the atmosphere;
  - following the action of ground water on chalk and limestone which can produce carbon dioxide and displace normal air;
  - in ships' holds, freight containers, lorries, etc., as a result of the cargo reacting with oxygen inside the space;
  - inside steel tanks and vessels when rust forms.
2. Poisonous gas, fume or vapour.
  - These can:
    - build-up in sewers and manholes and in pits connected to the system;
    - enter tanks or vessels from connecting pipes;
    - leak into trenches and pits in contaminated land, such as old refuse tips and old gas works.

3. Liquids and solids which can suddenly fill the space, or release gases into it, when disturbed. Free flowing solids such as grain can also partially solidify or 'bridge' in silos causing blockages which can collapse unexpectedly.
4. Fire and explosions (e.g. from flammable vapours, excess oxygen, etc.).
5. Residues left in tanks, vessels, etc., or remaining on internal surfaces which can give off gas, fume or vapour.
6. Dust may be present in high concentrations, e.g. in flour silos.
7. Hot conditions leading to a dangerous increase in body temperature.

Some of the above conditions may already be an inherent risk of the space eg a gas tank but some may arise through the work being carried out, or because of ineffective isolation of plant nearby, e.g. leakage from a pipe connected to the confined space. The enclosure and working space may increase other dangers arising through the work being carried out, for example:

- machinery being used may require special precautions, such as provision of dust extraction for a portable grinder, or special precautions against electric shock;
- gas, fume or vapour can arise from welding, or by use of volatile and often flammable solvents, adhesives, etc.;
- if access to the space is through a restricted entrance, such as manhole, escape or rescue in an emergency will be more difficult (see Emergency Procedures)

#### 4. Responsibilities

The Head of School or Unit shall ensure that:

- Use any other practicable means to undertake the work activity without anybody accessing the confined space eg using CCTV systems.
- Only trained members of staff can enter a confined space;
- A suitable and sufficient risk assessment being undertaken prior to a member of staff entering a confined space;
- All work activities in the confined space are assessed in terms of possible oxygen reduction or production of toxic gases;
- Measurements of oxygen levels and/or possible toxic being undertaken prior to entry to the confined space and that the measurements show the levels of oxygen are satisfactory or that no toxic gas is thought to be present
- A 'Permit to Work' being completed prior to entry;
- An adequate emergency evacuation plan is produced for the site which does **NOT** rely of the attendance of the Fire Service prior to entry into the confined space;
- There is continuous measurement of oxygen and possible toxic gases when staff are in the confined space

The workers shall ensure that they:

- Are suitably trained prior to entry into a confined space;
- They have read and understood the risk assessment for the entry and work in the confined space;
- That they comply with the 'Permit to Work' restrictions set;

- They continuously monitor oxygen and possible toxic gas levels and leave when these levels become hazardous;
- Understand the emergency evacuation plan from the confined space

Where contractors are used to access a confined space on behalf, the manager in control of the contract must get written evidence of how the contractor will comply with the above responsibilities from the company. As a 'Client' we are responsible for employing comply with the law.

## 5. What the law says

Before any work can be carried out in a confined space, a written and suitable risk assessment must be made prior to any work being carried out in a confined space (**The Confined Spaces Regulations 1999, Regulation 3**). For work in confined spaces this means identifying the hazards present, assessing the risks and determining what precautions to take which must include how to extract a worker from the confined space in an emergency. In most cases the assessment will include consideration of:

- the task;
- the working environment;
- working materials and tools;
- the suitability of those carrying out the task;
- arrangements for emergency rescue.

The HSE leaflet entitled 5 Steps to Risk Assessment will help you further. You may need to appoint competent people to help manage the risks and ensure that employees are adequately trained and instructed. In the assessment you should also consider:

- Previous contents;
- Residues which may remove oxygen or release toxic fumes;
- Contamination with toxic materials;
- Oxygen deficiency or enrichment (which may form a fire risk);
- Physical dimensions of the space;
- Use of solvents and other cleaning materials in such a space;
- Sources of ignition;
- Ingress of substances

If your assessment identifies risks of serious injury from work in confined spaces, such as the dangers highlighted above, the **Confined Spaces Regulations 1997** apply. These regulations contain the following key duties:

- avoid entry to confined spaces, e.g. by doing the work from outside;
- if entry to a confined space is unavoidable, follow a safe system of work; and
- put in place adequate emergency arrangements before the work starts.

## 6. Avoid entering confined spaces

You need to check if the work can be done another way so that entry or work in confined spaces is avoided. Better work-planning or a different approach can reduce the need for confined space entry.

Ask yourself if the intended work is really necessary, or could you:

- modify the confined space itself so that entry is not necessary;

- have the work done from outside, for example:
  - blockages can be cleared in silos by use of remotely operated rotating flail devices, vibrators or air purgers;
  - inspection, sampling and cleaning operations can often be done from outside the space using appropriate equipment and tools;
  - remote cameras can be used for internal inspection of vessels.

## 7. Safe systems of work

If you cannot avoid entry into a confined space make sure you have a safe system for working inside the space.

Use the results of your risk assessment to help identify the necessary precautions to reduce the risk of injury. These will depend on the nature of the confined space, the associated risk and the work involved.

Make sure that the safe system of work, including the precautions identified, is developed and put into practice. Everyone involved will need to be properly trained and instructed to make sure they know what to do and how to do it safely.

The following checklist is not intended to be exhaustive but includes many of the essential elements to help prepare a safe system of work.

### Appointment of a Supervisor

Supervisors should be given responsibility to ensure that the necessary precautions are taken to check safety at each stage and may need to remain present while work is underway. Supervisors should be trained in managing confined spaces and be aware of the potential risks of such spaces.

### Are persons suitable for the work?

Do they have sufficient experience of the type of work to be carried out, and what training have they received? Where risk assessment highlights exceptional constraints as a result of the physical layout, are individuals of suitable build? The competent person may need to consider other factors, e.g. concerning claustrophobia or fitness to wear breathing apparatus, and medical advice on an individual's suitability may be needed.

### Isolation

Mechanical and electrical isolation of equipment is essential if it could otherwise operate, or be operated, inadvertently. If gas, fume or vapour could enter the confined space, physical isolation of pipework etc. needs to be made. In all cases a check should be made to ensure isolation is effective.

### Equipment

The equipment used in the confined space must be suitable eg 'Inherently Safe' electrical systems in areas with highly flammable atmospheres or the use of 110V electrical systems to reduce the risk of electric shock in damp environments.

### Cleaning before entry

This may be necessary to ensure fumes do not develop from residues etc. while the work is being done.

### Check the size of the entrance

Is it big enough to allow workers wearing all the necessary equipment to climb in and out easily, and provide ready access and egress in an emergency? For example, the size of the opening may mean choosing air-line breathing apparatus in place of self-contained equipment which is more bulky and therefore likely to restrict ready passage.

### Provision of ventilation

You may be able to increase the number of openings and therefore improve ventilation. Mechanical ventilation may be necessary to ensure an adequate supply of fresh air. This is essential where portable gas cylinders and diesel-fuelled equipment are used inside the space because of the dangers from build-up of engine exhaust.

**Warning: *Carbon monoxide in the exhaust from petrol-fuelled engines is so dangerous that use of such equipment in confined spaces should never be allowed.***

### Testing the air

This may be necessary to check that it is free from both toxic and flammable vapours and that it is fit to breathe. Testing should be carried out by a competent person using a suitable gas detector which is correctly calibrated. Where the risk assessment indicates that conditions may change, or as a further precaution, continuous monitoring of the air may be necessary.

### Provision of breathing apparatus

This is essential if the air inside the space cannot be made fit to breathe because of gas, fume or vapour present, or lack of oxygen. Never try to 'sweeten' the air in a confined space with oxygen as this can greatly increase the risk of a fire or explosion.

### Preparation of emergency arrangements

This will need to cover the necessary equipment, training and practice drills.

### Provision of rescue harnesses

Lifelines attached to harnesses should run back to a point outside the confined space.

### Communications

An adequate communications system is needed to enable communication between people inside and outside the confined space and to summon help in an emergency.

## Check how the alarm is raised

Is it necessary to station someone outside to keep watch and to communicate with anyone inside, raise the alarm quickly in an emergency, and take charge of the rescue procedures? If so, the alarm messages must be easily interpreted (eg one pull on a line etc) and should be made very clear to worker entering the confined space and the emergency person standing at the entrance.

## 'Permit-to-Work'

A permit-to-work ensures a formal check is undertaken to ensure all the elements of a safe system of work are in place before people are allowed to enter or work in the confined space. It is also a means of communication between site management, supervisors, and those carrying out the hazardous work. Essential features of a permit-to-work are:

- clear identification of who may authorise particular jobs (and any limits to their authority) and who is responsible for specifying the necessary precautions (e.g. isolation, air testing, emergency arrangements, etc.);
- provision for ensuring that contractors engaged to carry out work are included;
- training and instruction in the issue of permits;
- monitoring and auditing to ensure that the system works as intended.

The 'Permit to Work Form' in appendix 1 should be completed and signed by a 'Competent' person who has received appropriate training in confined spaces management.

## **8. Emergency Procedures**

When things go wrong, people may be exposed to serious and immediate danger. Effective arrangements for raising the alarm and carrying out rescue operations in an emergency are essential. All emergency egress plans **must not rely** on the attendance of the Fire Service. A robust management plan (or a plan from a contractor) must be made prior to entry into the confined space. All workers entering the confined space and those acting as rescuers on the surface must be shown this plan and fully understand it.

Contingency plans will depend on the nature of the confined space, the risks identified and consequently the likely nature of an emergency rescue.

Emergency arrangements will depend on the risks. You should consider:

**Communications** - How can an emergency be communicated from inside the confined space to people outside so that rescue procedures can start? Don't forget night and shift work, weekends and times when the premises are closed, e.g. holidays. Also, consider what might happen and how the alarm can be raised.

**Rescue and resuscitation equipment** - Provision of suitable rescue and resuscitation equipment will depend on the likely emergencies identified. Where such equipment is provided for use by rescuers, training in correct operation is essential.

**Capabilities of rescuers** - There need to be properly trained people, sufficiently fit to carry out their task, ready at hand, and capable of using any equipment provided for rescue, e.g. breathing apparatus, lifelines and fire-fighting equipment. Rescuers also need to be protected against the cause of the emergency.

### **Guidance Documents**

Approved Code of Practice (ACOP), "Safe work in confined spaces" (1997) HSC

Leaflet entitled "Safe Work in Confined Spaces" INDG258 (2005) HSE

University of St Andrews
Confined Space Entry - Permit to Work
(Chambers, tanks, pits, vessels etc)

1. Do you really need a permit?

(i) Is there a risk of:

- (a) Fire or explosion? Yes [ ] No [ ]
(b) An increase in body temperature? Yes [ ] No [ ]
(c) Build up of gas, fumes or vapour? Yes [ ] No [ ]
(d) Oxygen deficiency? Yes [ ] No [ ]
(e) Drowning? Yes [ ] No [ ]
(f) Asphyxiation by a free flowing solid? Yes [ ] No [ ]

(ii) Can the objective be achieved without entry? Yes [ ] No [ ]

2. Location of Confined Space Give exact details of the location of the confined space giving entry points and egress points (attach a diagram if necessary) with details of possible hazards (eg gas pipes, water pipes, sewage pipes etc)

.....
.....

3. General Condition

(a) What were the previous contents?

.....

(b) Are residues likely?

.....

(c) Is there any possibility of subsequent contamination?

.....

(d) Can the atmosphere become deficient or rich in oxygen?

.....

(e) Do the physical dimensions of the confined space give rise to any risks or special considerations?

.....

.....

4. Work Derived

- (a) Cleaning chemicals or solvents to be used? .....
- (b) Other substances used/processes emitting substances?.....
- (c) Hot work/ ignition sources? .....
- (d) Other Work activities which may affect the confined space .....

5. Outside Derived

- (a) Has the confined space been isolated / locked out of the process?      Yes  No
- (b) Is there a risk of ingress of any other substances during the work?      Yes  No

6. Emergency Rescue

Please describe arrangements:

.....

.....

.....

**Arrangements for Safe Working in Confined Space**

**(NB please refer to Approved Code of Practice for guidance on standards)**

**PLEASE DESCRIBE IN FULL ALL OF THE FOLLOWING:**

(i) Competency of operative .....

(ii) Competency of supervision.....

(iii) Testing/monitoring arrangements.....

(iv) Gas purging and ventilation.....

(v) Removal of all residues.....

(vi) Isolation from substances.....

(vii) Isolation for physical risks.....

(viii) Equipment specification.....

(ix) PPE specification.....

(x) Other risks: Gas cylinders? .....

Engines? .....

Gas pipes/hoses? .....

(xi) Access/Egress.....

- (xii) Fire prevention .....
  - (xiii) Lighting.....
  - (xiv) Static electricity.....
  - (xv) Emergencies and rescue... ..
  - (xvi) How will operatives' time in the confined space be limited?.....
- 

Permit Number .....

This 'Confined Space' has been deemed to be accessible given the above information and appropriate emergency procedures described

Permit issued by

Name ..... Signature ..... Time ..... Date .....

Permit **Revoked** by

Name ..... Signature ..... Time ..... Date .....

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